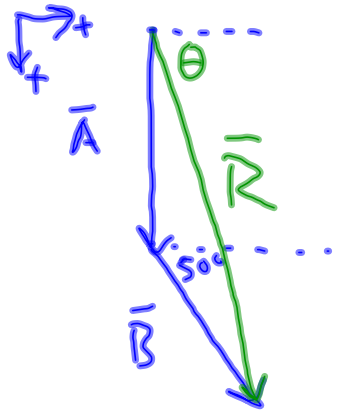
River Problems:

- Vector problem because boat and current both have velocity
- We can find net velocity, displacement, time

As a boat travels 3.33 m/s due south, there is a current pushing 2.22 m/s at 50 degrees south of east. What is the resultant speed and direction of the boat?



$A_x = (3.33\ m/s)\cos(90°) = 0$

$+\ B_x = (2.22\ m/s)\cos(50°)$

$R_x = 1.427\ m/s$

$A_y = 3.33\ m/s$

$+\ B_y = (2.22\ m/s)\sin(50°)$

$R_y = 5.03\ m/s$

$R^2 = R_x^2 + R_y^2$

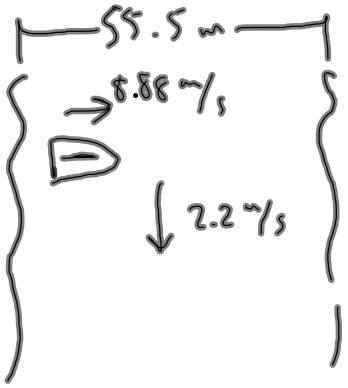
$R = 5.23\ m/s$

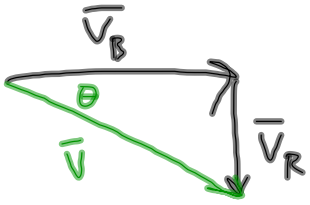
$\tan\theta = \frac{R_y}{R_x}$

$\theta = 74.1°$

$\bar{R} = 5.23\ m/s$ @ $74.1°$ South of East

A boat travels due east at 8.88 m/s. There is also a 2.2 m/s current south acting on the boat. The river is 55.5 m wide.
a) How long will it take the boat to cross the river?
b) How far downstream will it end up from where it started?





a) $V = \frac{d}{t}$

$t = \frac{d}{v}$

$= \frac{55.5\ m}{8.88\ m/s}$ ← displacement to cross the river / ← velocity to cross the river

$= 6.25\ s$

- the direction of the displacement and velocity vectors must match

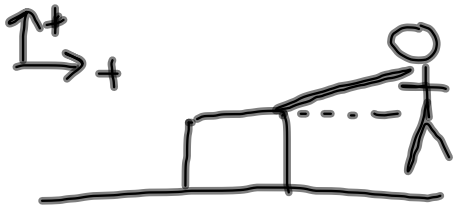
b) $V = \frac{d}{t}$

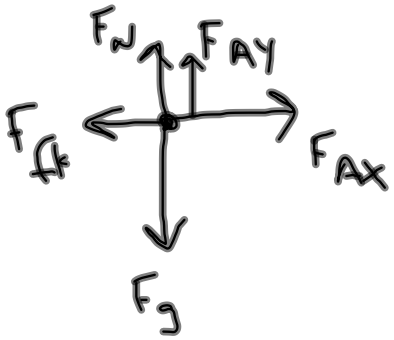
$d = vt$ velocity in y-direction

$= (2.2\ m/s)(6.25\ s)$ $\left(\frac{m}{s}\right)\left(\frac{s}{1}\right)$

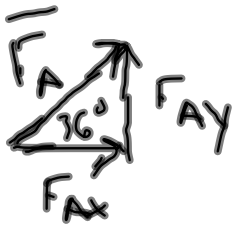
$= 13.75\ m$

A 2.5 kg crate is pulled by a rope with 30.0 N at 36 degrees above the horizontal, and the coefficient of friction between the crate and floor is 0.222. What will be the acceleration of the crate?





$$\sum \vec{F}_x = m\vec{a}_x$$



$$a_x = \frac{\sum F_x}{m}$$

$$= \frac{F_{Ax} - F_{fk}}{m}$$

$$F_{fk} = \mu_k F_N$$

$$= \mu_k (F_g - F_{AY})$$

$$\sum \vec{F}_y =$$

$$F_N + F_{AY}$$

$$-F_g =$$

$$F_N = F_g -$$

$$F_g = ma_g$$

$$F_{AY} = F_A \sin(36°)$$

$$= \frac{F_A \cos(36°) - \mu_k (F_g - F_{AY})}{m}$$

$$= \frac{1}{m}\left[F_A \cos(36°) - \mu_k m a_g - \mu_k F_A \sin(36°)\right]$$

$$= 9.12\ m/s^2$$